ASK take it easy

Sudan University of Science and Technology

School of Electronic Engineering

Test no. 1

Subject: Electromagnetic Fields

Date: 02 /08 /2015

Sem: 7

Time: 1hrs

Answer all questions

Question 1:

1. Point charges of 50 nC each are located at A(1,0,0), B(-1,0,0), C(0,1,0) and D(0,-1,0) in free space. Find the total force on the charge at A.
2. Given the electric field $E = (4x - 2y)_{a_x} - (2x + 4y)_{a_y} v/m$, find the equation of that streamline passing through point $(2,3,-4)$, then find a unit vector a_E specifying the direction of E at $(3,-2,5)$.

Question 2:

Given the electric flux density, $D = (2x+1)y^2{}_{a_x} + 2x(x+1)_{a_y}\ C/m^2$ evaluate the total charge enclosed in the area: $x = 5, -2 \le y \le 2, -2 \le z \le 2$.

ay

ax dy dz ax = ds

Question 3:

Let $V(x,y) = 4e^{2x} + f(x) - 3y^2$ in a region of free space where $\rho_v = 0$. It is known that both E_x and V are zero at the origin. Find $f(x)$ and $V(x,y)$.

All the Best

Dr. Mohamed Hussien

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Question 1:

Answer all questions

1. Let a point charge $Q_1 = 25\,nC$ be located at $p_1(4,-2,7)$ and a charge $Q_2 = 60\,nC$ be at $p_1(-3,4,-2)$. At which point on the y axis is $E_x = 0$.
2. A point charge Q lies at the origin. Show that $div(D)$ is zero everywhere except at the origin.

Question 2:

0.048

13.2
+77.2

It is known that the potential is given as $V = 80\rho^{0.6}$ V. Assuming free space conditions, find: a) the electric field intensity. b) the volume charge density at $\rho = 0.5$ m. c) the total charge lying within the closed surface $\rho = 0.6, 0 < z < 1$.

C -22.11

Question 3:

A non-uniform volume charge density, $\rho_v = 120r \quad C/m^3$, lies within the spherical surface in spherical coordinate system. Find: a) the electric flux density everywhere. b) the electric flux density at $r = 1$ m.

All the Best
Dr. Mohamed Hussien

Subject ______ موضوع الدرس

Date : / / الموافق / / التاريخ

حل مسائل / محاضرة كهرو

① مسأله في الشرح الاول

$E = (4x - 2y)a_x - (2x + 4y)a_y$

Sol

$$\frac{E_x}{E_y} = \frac{dx}{dy} = \frac{4x - 2y}{2x + 4y}$$

$$E = E_x a_x + E_y a_y + E_z a_z$$

$$4x\,dy - 2y\,dy = -2x\,dx - 4y\,dx$$

$$2x\,dx - 2y\,dy = -4(y\,dx + x\,dy)$$

باخذ التكامل

$$x^2 - y^2 = -4(xy) + c$$

$$y^2 = x^2 + 4xy + *$$

so bad
في كبجه سيئة

$$a_E = \frac{\bar{E}}{|E|}\Big|_{(3,-2,5)}$$

التفاضل والتكامل مهارات فردية

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② ٩ نشرة البنات

Question (2)

Sol.

$E = -\nabla V$

$\nabla V = \frac{\partial V}{\partial \rho} a_\rho + \frac{1}{\rho}\cancelto{0}{\frac{\partial V}{\partial \phi}} a_\phi + \cancelto{0}{\frac{\partial V}{\partial z}} a_z$

$E = -48\rho^{-4} \Big|_{\rho=0.6}$ V/m

$\rho_v = \nabla \cdot D$

$D = \varepsilon_0 E$

$= \frac{1}{\rho}\frac{\partial}{\partial \rho}(\rho D_\rho) \Big|_{\rho=0.8}$

$Q = 4\pi r^2 D$ C ← colomb

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③ في تسبت البنات

Q 1 / 2

Sol

أي شيء موضوع في الفراغ فأخذ إحداثيات بالإحداثيات الكروية.

$Q \quad \text{div } D = 0$

$D = \frac{Q}{4\pi r^2} a_r$ قيمة D في الإحداثيات الكروية

$\text{div } D = \frac{1}{r^2}\frac{\partial}{\partial r}(r^2 D_r) + \overset{0}{\cancel{\cdots D_\theta}} + \overset{0}{\cancel{\cdots D_\phi}}$

$D_r = \frac{Q}{4\pi r^2}$

$\text{div } D = ?$

$\frac{1}{r^2}\frac{\partial}{\partial r}\left(r^2 \frac{Q}{4\pi r^2}\right) = 0 = \text{div } D$

احتمال يجيبوه في إمتحان تاني

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④ فرشتت البنات

كمل Q_3

Sol

$$D = \frac{Q}{4\pi r^2} a_r$$

$$Q = \int_{Vol} \rho_v \cdot dv$$

$$Q = \int_{r=0}^{1} \int_{\theta=0}^{\pi} \int_{\phi=0}^{2\pi} 120r \overbrace{(dr\, d\theta\, d\phi)\, r^2 \sin\theta}^{dv}$$

ثم نكمل عادي

المسائل اللي حلها في الفصل إحتمال كبير

يجيبها في الامتحان (زي ما عملت للشيت).

$$D\Big|_{r=1} = \frac{Q}{4\pi r^2}\Big|_{r=1}$$

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⑤ في شيت الدكتور

Q 1/1

Sol

"مسألة ساهلة جداً جداً"

⑥ في شيت الدكتور

Q1/2

Sol

نوجد الابعاد

نوجد القوى

نجمع القوى

$$F_{BA} = \frac{Q_A Q_B}{4\pi \varepsilon_0 R^2_{BA}} a_{R_{BA}}$$

F_{CA}

F_{DA}

$$F_{TOT} = F_{BA} + F_{CA} + F_{DA}$$

⑦ شيت البنات

Q 1 / 1

Sol

فكرة الحل

نسمي هذه النقطة على محور y

وهي $P(0, y, 0)$

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$P_2(-3,4,-2)$ $P_1(4,-2,7)$

E_2 E_1

$P(0,y,0)$

نوجد E_1 و E_2

$$E_{Tot} = E_2 + E_1 = 0$$

نوجد قيمة y

(8) شيت ا و د

Q3

Sol

~~4ex,~~ $V(x,y) = 4e^{2x} + f(x) - 3y^2$ الحل

$\rho_v = 0$, E_x & V are zero $|_{(0,0,0)}$

$f(x)$ E & $V(x,y)$

Sol

فكرة الحل

$\nabla^2 V =$ {القانون}

$$\frac{\partial V}{\partial x} = 8e^{2x} + \frac{d f(x)}{dx} = 0$$

$$\frac{\partial^2 V}{\partial x^2} = 16e^{2x} = \frac{d^2 f(x)}{dx^2}$$

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$$\frac{\partial v}{\partial y} = -6y \quad , \quad \frac{\partial^2 v}{\partial y^2} = -6$$

$$\frac{\partial v}{\partial z} = \frac{\partial^2 v}{\partial z^2} = 0$$

$$\therefore \nabla^2 v = 16e^{2x} + \frac{d^2 f(x)}{dx^2} - 6 = 0$$

$$\frac{d^2 f(x)}{dx^2} = 6 - 16e^{2x}$$

$$\frac{d f(x)}{dx} = 6x - 8e^{2x} + C_1$$

$$f(x) = 3x^2 - 4e^{2x} + C_1 x + C_2$$

$C_1 = C_2 = 0$ ~~C_1 & C_2~~ $=$ جز ثقة ها

" نحطو قيمها بجيبها في الامتحان "

$$\therefore f(x) = 3x^2 - 4e^{2x}$$

$$V(x,y) = 4e^{2x} + 3x^2 - 4e^{2x} - 3y^2$$

$$V(x,y) = 3x^2 - 3y^2 = 3(x^2 - y^2)$$

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(9) لشيت الأول

Q2

Sol

$Q = \oint_s D_s \cdot ds$

$ds = dy\, dz \cdot a_x$

$x = 5$ const ثابت

$Q = \int_{y=-2}^{2} \int_{z=-2}^{2} (2*5+1) y^2 ~~+ 2*5~~ \, dy\, dz$

(10)

أوجد من نظرية ستوكس

$Q = 10 \sin\theta \, a_\phi \quad r = 3$

$0 \leq \theta \leq 90°$

$0 \leq \phi \leq 90°$

Sol

$\oint Q\, dl = \int_s (\nabla \times Q)\, ds$